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(71) Applicant
Delco Electronics Corporation

(Incorporated in the USA – Indiana)

700 East Firmin Street, Kokomo, Indiana 46902, United States of America

(72) Inventors
Morgan Daniel Murphy
Curtis Allen Stapert

(74) Agent and/or Address for Service
R Jehan
Vauxhall Motors Limited, 1st Floor, Gideon House, 28 Chapel Street, Luton, Beds, LU1 2SE, United Kingdom

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GB 2259143 A
Popular Science, January 1992, pages 43,44, "Two-way instruments".

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(54) Vehicle instrument display apparatus

(57) In a vehicle instrument panel, an analogue display panel (18) faces a display direction, and includes a first light source (16) for lighting the analogue display panel (18), at least one analogue gauge mechanism (42) driving a pointer (22), and a second light source (38) for lighting the pointer (22). An electronic display (76) is mounted perpendicular to the analogue display panel (18). A partially reflective and partially light transmissive optical element (90) is included so that, when the first and second light sources (16, 38) are illuminated, the analogue display panel (18) and pointer (22) are visible through the optical element (90), also so that, when the electronic display (76) is emissive, an image of the electronic display (76) is projected by the optical element (90). The analogue display panel (18) and the pointer (22) are hidden when the first and second light sources (16, 38) are not illuminated and the electronic display (76) is hidden when the electronic display (76) is not light emissive.

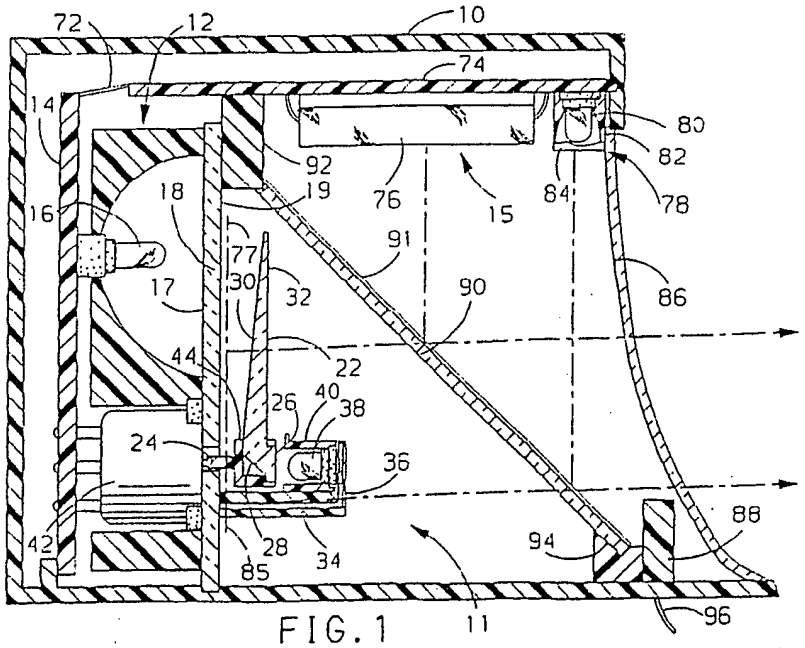

FIG. 1

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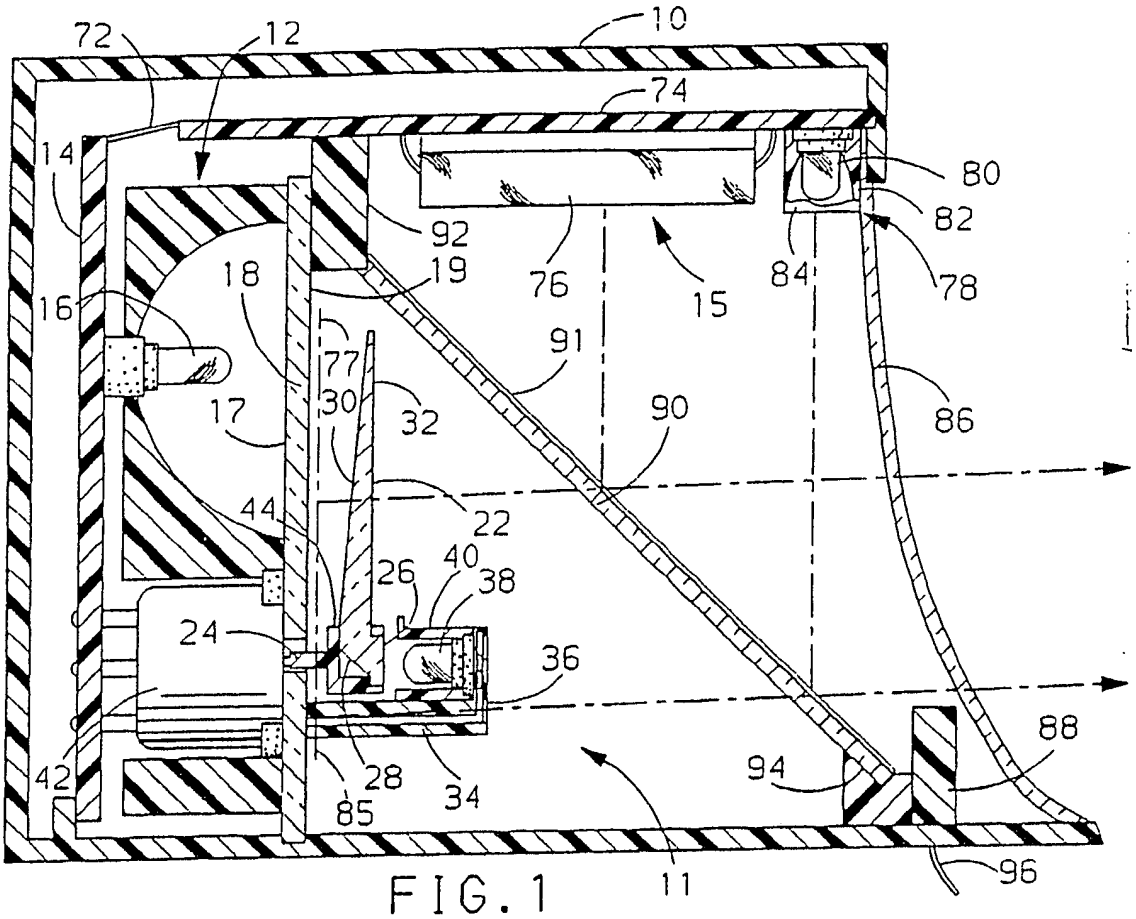
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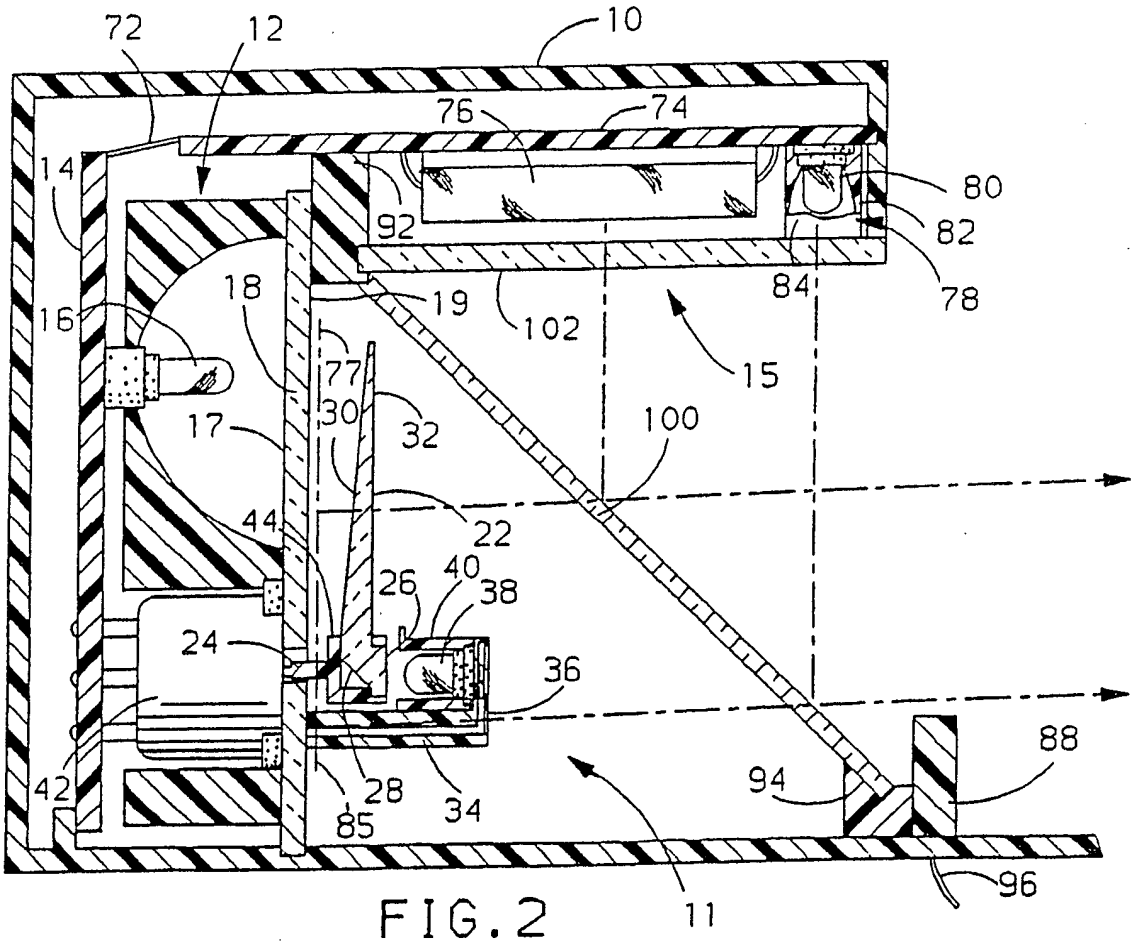
12
10
74
14
80
82
92
19
76
84
78
16
18
15
91
77
30
32
17
90
86
44
22
26
40
38
24
36
88
42
28
34
94
85
11
96

FIG. 1


72
12
10
76
74
14
80
92
82
84
78
18
19
102
16
15
77
30
32
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88
42
28
34
94
85
11
96

FIG. 2

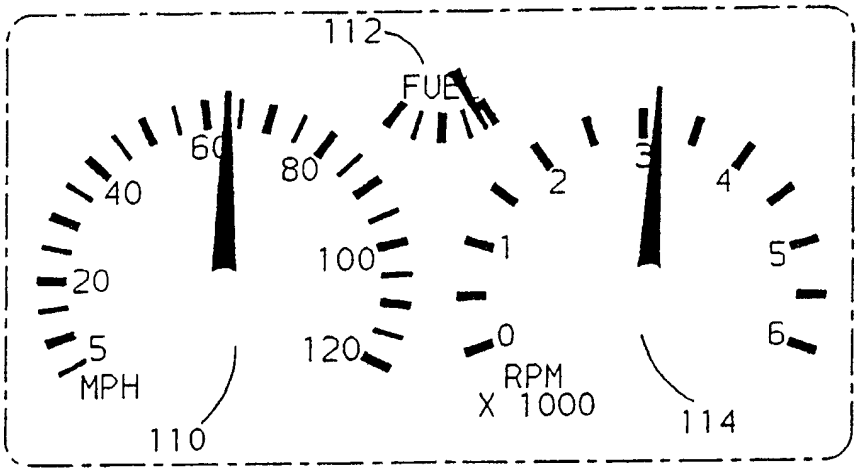
112
FUEL
40
60
80
100
120
20
5
MPH
110
1
2
3
4
5
6
0
RPM
X 1000
114

FIG. 3

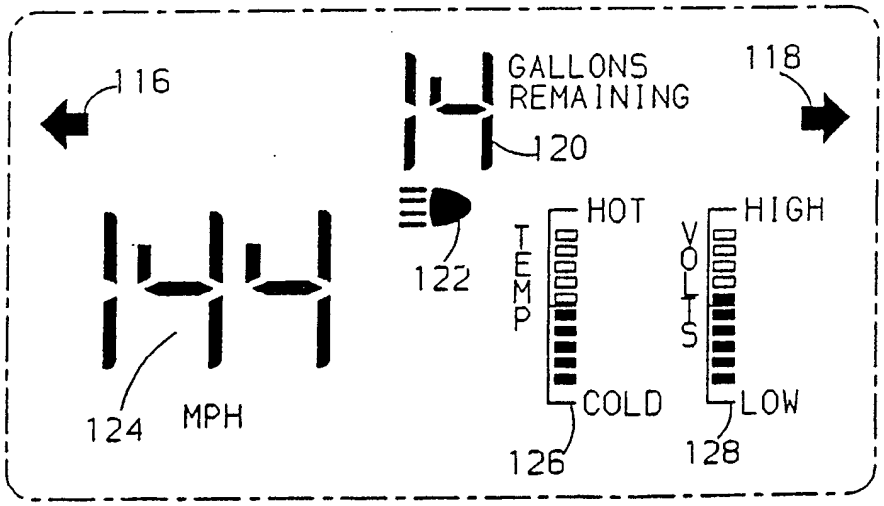
116
GALLONS
REMAINING
118
120
122
HOT
TEMP
COLD
126
HIGH
VOLTS
LOW
128
124
MPH

FIG. 4

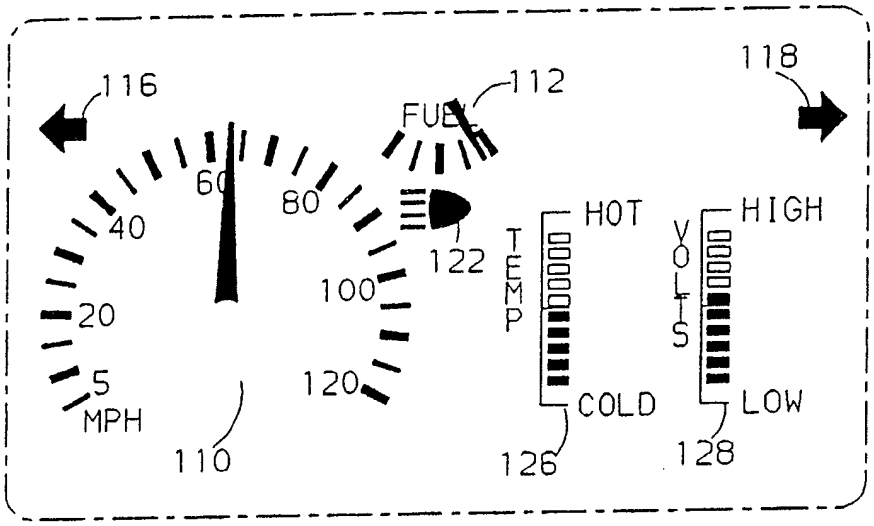
116
118
112
FUEL
60
80
40
100
20
120
5
MPH
110
122
TEMP
HOT
COLD
126
VOLTS
HIGH
LOW
128

FIG.5

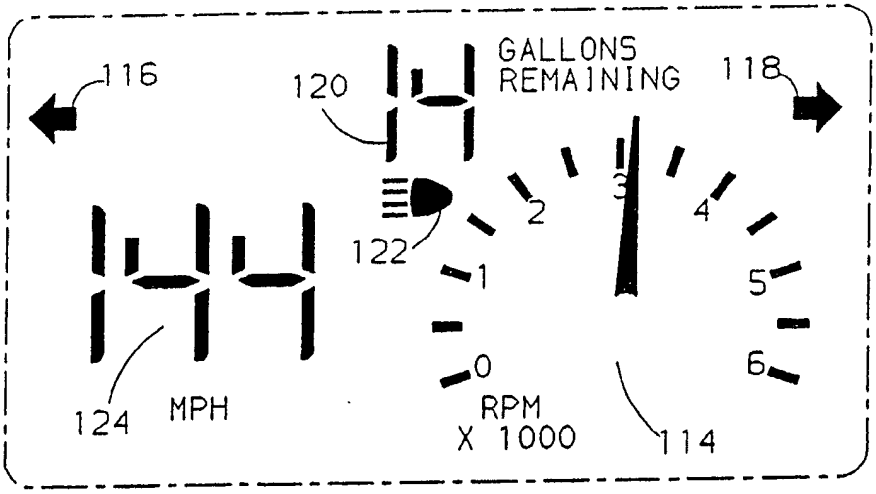
116
120
GALLONS
REMAINING
118
122
2
3
4
1
5
0
6
124
MPH
RPM
X 1000
114

FIG.6

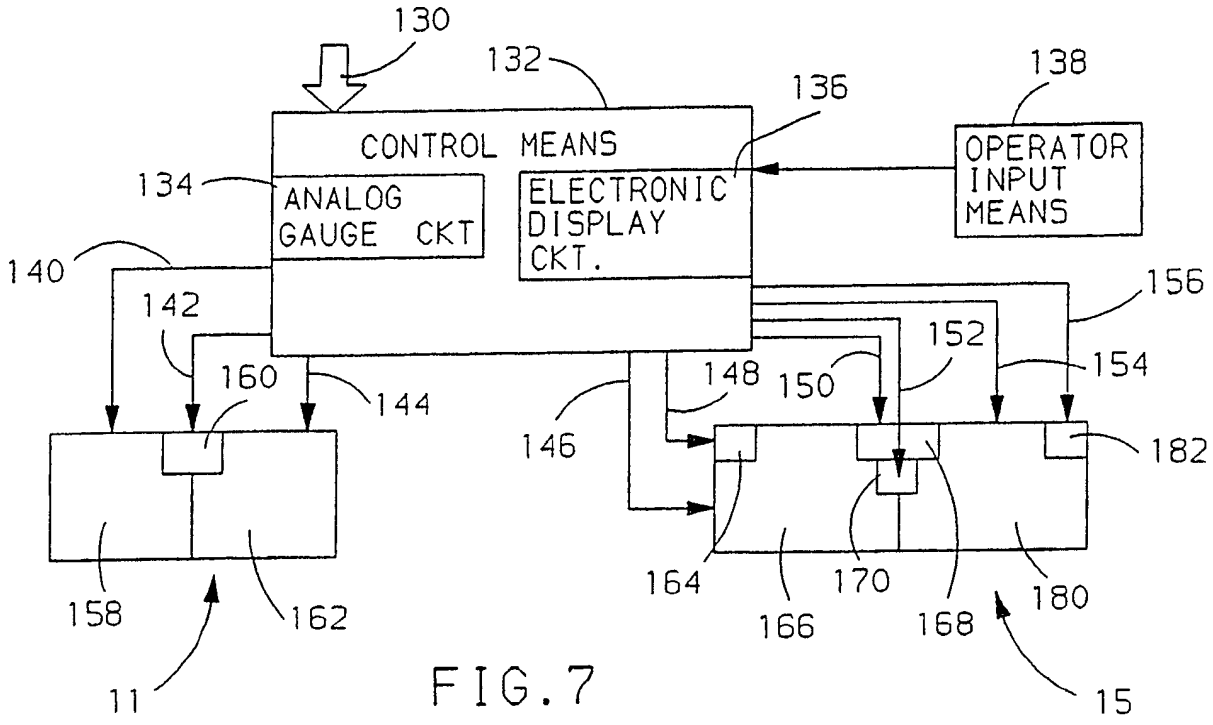
130
132
136
138
CONTROL MEANS
134
ANALOG GAUGE CKT
ELECTRONIC DISPLAY CKT.
OPERATOR INPUT MEANS
140
142
156
152
154
160
144
148
150
146
182
158
162
164
170
180
166
168
11
15

FIG. 7

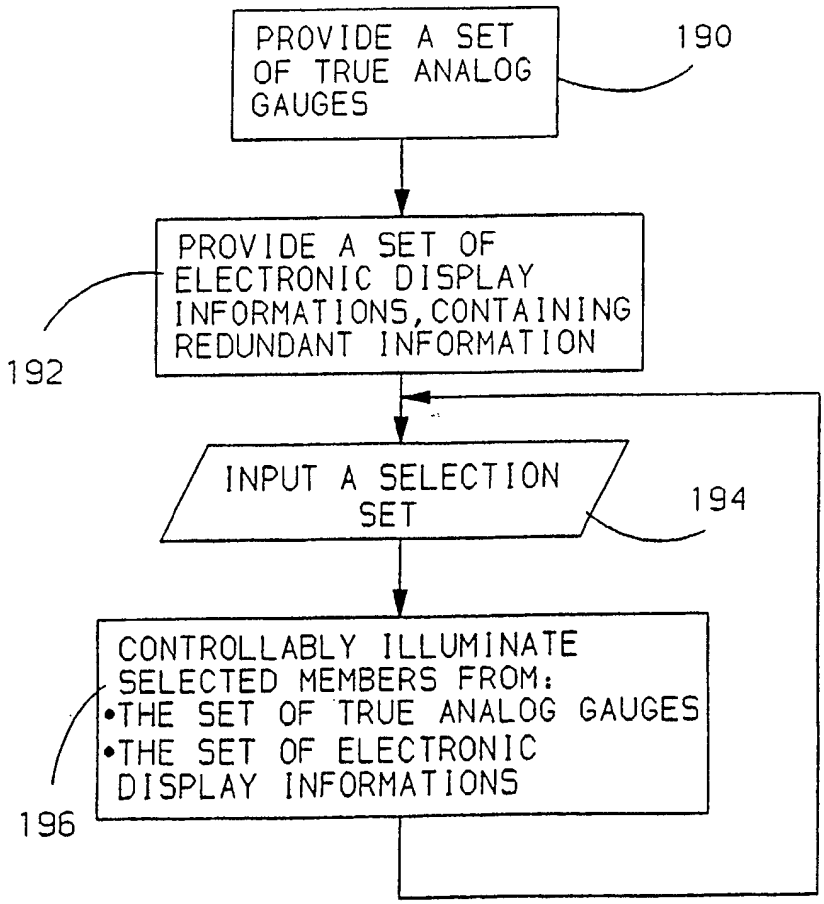
PROVIDE A SET OF TRUE ANALOG GAUGES
190
PROVIDE A SET OF ELECTRONIC DISPLAY INFORMATIONS, CONTAINING REDUNDANT INFORMATION
192
INPUT A SELECTION SET
194
CONTROLLABLY ILLUMINATE SELECTED MEMBERS FROM:
•THE SET OF TRUE ANALOG GAUGES
•THE SET OF ELECTRONIC DISPLAY INFORMATIONS
196

FIG. 8

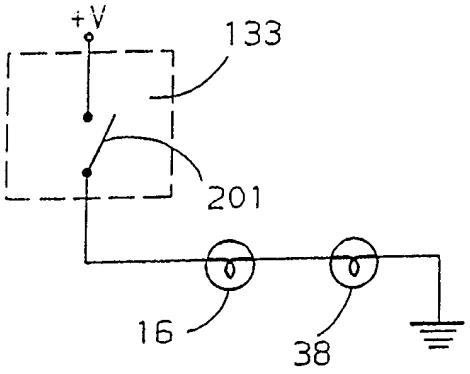

FIG.9

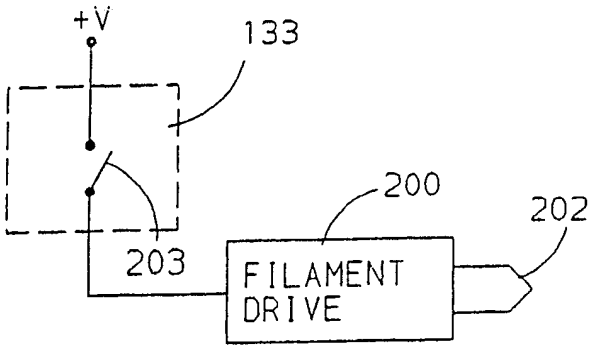

FIG.10

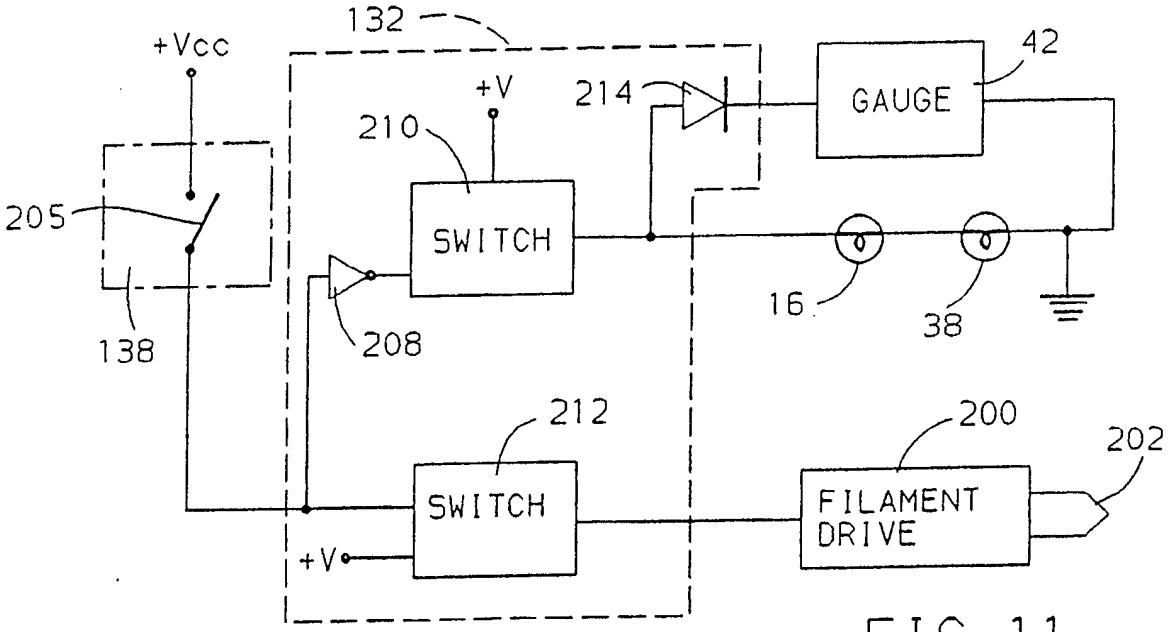

FIG.11

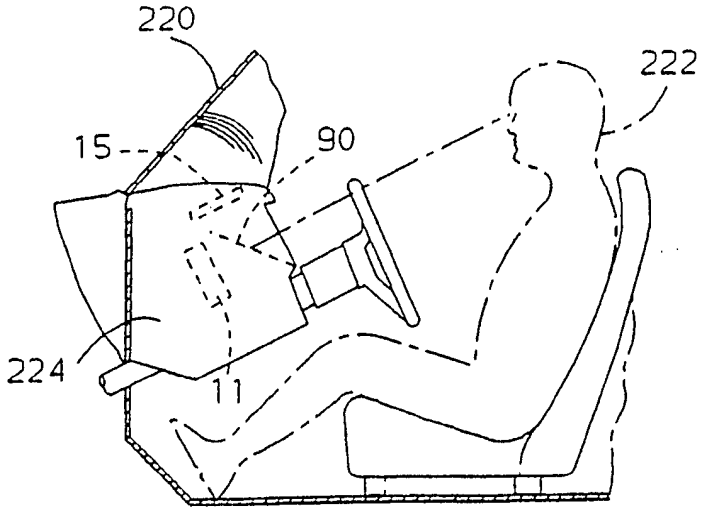

FIG.12

DISPLAY APPARATUS

This invention relates to display apparatus for a vehicle instrument panel.

Typical vehicle instrumentation displays operate predominantly in a single display mode. For example, a vehicle may have analogue gauges, an electronic display or a fixed mixture of both. In some vehicles, the scale for the gauges is selectable between English and Metric. In some vehicles with electronic displays, the electronic display is reconfigurable to display different information or show the information in a variety of formats. For example, the electronic display may be configurable to show the information in digital form or in "simulated" analogue form, in which the display generates an electronic image simulating an analogue gauge. These displays are limited in the type of information shown, in that the vehicle driver has only a limited selection of display appearances.

To provide flexibility of display types, vehicle manufactures have offered alternative display options for new vehicles. These options are limited, however, in that once a display is installed, the vehicle is limited to that display.

Some conventional instrumentation clusters have had a "hidden-until-lit" feature, in which the display remains invisible to the viewer until power is supplied to the display, which usually occurs at key-on of the vehicle, at which time the display becomes visible to the viewer. Some of these "hidden-until-lit" displays involve electronic displays and others involve more conventional analogue displays.

The present invention seeks to provide improved display apparatus.

According to an aspect of the present invention, there is provided display apparatus for a vehicle instrument panel comprising an analogue display panel mounted in a plane substantially perpendicular to a viewing direction of the display apparatus; first lighting means for illuminating the analogue display panel; at least one analogue gauge including a rotatable spindle; a pointer mounted on the rotatable spindle and adapted in use to be illuminated; second lighting means for illuminating the pointer; an electronic display mounted in a plane substantially parallel to the viewing direction; an optical element disposed at an angle relative to the analogue display panel, the analogue display panel and pointer being visible through the optical element when the first and second lighting means are lit, an image of the electronic display being projected by the optical element when the electronic display is actuated; and hiding means for hiding from view the analogue display panel when the first lighting means is not lit, the pointer when the second lighting means is not lit and the electronic display when the electronic display is not actuated.

The invention can provide a two-page instrumentation display for a motor vehicle.

Advantageously, there is provided a display selectable between an electronic-type display and an actual conventional analogue display.

Advantageously, there is provided a two-page display having a "hidden-until-lit" feature.

Advantageously, there is provided a two-page display which is flexible between an electronic and an analogue display format.

Preferably, there is provided a display which is configurable by a vehicle operator, as opposed to being fixed during vehicle production. There may be provided a configurable display in which a configuration option that may be operational or non-operational includes conventional (true) analogue gauges.

In an embodiment, the apparatus comprises an analogue gauge display panel mounted in a plane perpendicular to a display direction, means for lighting the analogue gauge display panel, at least one analogue gauge mechanism, a lit pointer for the analogue gauge mechanism, and means for lighting the lit pointer. An electronic display is mounted in a plane parallel to the display direction and perpendicular to the display panel. A partially reflective/partially light transmissive optical element is positioned in front of the analogue gauge display panel, mounted at an angle so that when the means for lighting the analogue gauge display panel and the means for lighting the lit pointer provide light, the analogue gauge display panel and the lit pointer are visible through the optical element. Also, the optical element is mounted so that when the electronic display is active, an image of the electronic display image is visible off of the optical element.

Preferably, there is also provided a flexible two-page display system having as a first page, a set of analogue displays of the type described above, the lighting means for each analogue display being individually controllable. As a second page, a digital display is provided and capable of providing a set of electronic display information. Input means may provide operator input of the type of information desired from among the sets of analogue displays electronic display

information. Control means, responsive to the input means, selectively controls the two-page display so that only the desired analogue and electronic display information is visible to the viewer.

According to another aspect of the present invention, there is provided a method of displaying information comprising the steps of providing a set of analogue gauges, each controllable to be illuminated and visible or non-illuminated and hidden; providing a set of electronic displays containing information redundant to at least one of the analogue gauges, each controllable to be non-illuminated and hidden or illuminated and viewed in combination with illuminated analogue gauges; receiving and operator input selection indicative of the analogue gauge or gauges and/or the electronic display or displays to be illuminated; and illuminating the selected analogue gauge or gauges and/or electronic display or displays, wherein if an electronic display redundant to one of the analogue gauges is selected, said analogue gauge is not illuminated so as to be hidden.

Some embodiments of the present invention are described below, by way of illustration only, with reference to the accompanying drawings, in which:

Figure 1 is a side elevational view in cross-section of an embodiment of display apparatus;

Figure 2 is a side elevational view in cross-section of a second embodiment of display apparatus;

Figures 3-6 are example display configurations provided by the apparatus of Figure 1 or 2;

Figure 7 is a block diagragm of an embodiment of flexible two-page display system;

Figure 8 is a flow chart of the display method used in the system of Figure 7;

Figure 9 is a circuit diagram of an embodiment of analogue gauge input selector and controller;

Figure 10 is a circuit diagram of an embodiment of electronic display input and controller;

Figure 11 is a circuit diagram of an embodiment of input selector and controller for both an analogue gauge and a corresponding redundant electronic display; and

Figure 12 is an illustration of the apparatus of Figure 1 or 2 fitted in a vehicle instrument panel.

Referring to Figure 1, a true analogue display is provided by an analogue gauge mechanism which includes a gauge 42, a light pipe pointer 22, a graphics panel 18, and light sources 16 and 38. An electronic display is provided by vacuum fluorescent display 76 and optical element 90. A partially transparent cover 86 through which the displays are viewed is mounted on the front of housing 10.

A first circuit board 14 is mounted within housing 10 and supports light source 16 and analogue gauge 42, both of which are electrically connected to first circuit board 14 in a manner well known to those skilled in the art. The display panel 18 is mounted orthogonally to a display or viewing direction with light receiving surface 17 facing both light source 16 and analogue gauge 42 and with the viewing surface 19 facing the display direction as shown. Rotatable spindle 24 of the analogue gauge 42 protrudes through an opening in the display panel 18 so that the light pipe pointer 22 may be attached to the spindle 24 on the

viewing surface 19 side of panel 18 as shown.

Light source 16 and reflector 12 together form means for backlighting the panel 18 by shining light onto the light receiving surface 17 of the panel 18. The panel 18 is viewed from the side of viewing surface 19 and, when backlit, shows lit graphics symbols in which, for example, either graphics characters themselves are lit or a background is lit and the graphics characters appear as blacked-out shadows. The display panel 18 is of a type well known to those skilled in the art.

One way of constructing display panel 18 is to provide a generally transparent or translucent panel and apply thereon an opaque mask, for example an opaque paint, in patterns to black out the portions of the panel 18 which are not intended to be illuminated. Filtering may be provided in the panel 18 to provide colouring for the whole or portions of panel 18 when backlit.

The light pipe pointer 22 is attached to the gauge spindle 24 as shown and is formed of a light transmitting material having a light receiving surface 26 centred on the axis of the spindle 24 facing the display direction as shown. Light source 38 is mounted proximate the light receiving portion 26 on the axis of the spindle 24 opposite the light pipe pointer 22 from the panel 18 and provides light to the light pipe pointer 22 via light receiving surface 26. The light from light source 38 travels into the light pipe pointer 22 and is reflected off of reflecting surface 28 into the arm of the light pipe pointer 22. The light then generally reflects off of surface 30 and out of exit surface 32 so that the pointer 22 appears brightly lit.

The axial positioning of light source 38 provides uniformly bright lighting of the pointer 22 throughout all rotational positions of the pointer 22.

Plastics body 44 retains the light piping portions of the light pipe pointer 22 and is opaque to prevent light leaks around the axial portions of the pointer. Light source 38 is supported by support 34 having an arm 36 extending over the axis of the spindle 24 as shown. An opaque plastics cap 40 mounted on light source 38 prevents light leaks from the light source in all directions except towards the light receiving surface 26 of the pointer 22. The support 34 is fixedly mounted to the panel 18 in any suitable manner well known to those skilled in the art.

A second circuit board 74 is mounted in the housing substantially perpendicular to the first circuit board 14 and electrically coupled to the first circuit board 14 through connector 72. Vacuum fluorescent display 76 is mounted to the second circuit board 74 in a manner well known to those skilled in the art and is substantially perpendicular to the display panel so as to face a direction substantially perpendicular to the viewing direction.

Optical element 90, comprising a partially reflective and a partially light transmissive combiner elements, is mounted in mounts 92 and 94 at an angle to both panel 18 and vacuum fluorescent display 76. Optical element 90 may comprise a partially silvered mirror with a coating 91 on one surface to provide the partial reflectivity, or may comprise any other suitable partially transmissive, partially reflective combiner. Optical element 90 allows the analogue display 11 to be viewed through optical element 90 and projects a virtual

image 77 of the electronic display 15 so that the virtual image 77 of electronic display 15 appears in combination with the analogue display 11.

The cover 86 comprises any suitable partially transmissive, partially opaque lens. In one implementation, cover 86 is moulded from a dark coloured plastics material with 50 percent or less light transmissivity. In another implementation, a dark coloured plastics layer is applied to a conventional clear cover.

The cover 86 prevents viewing of analogue display 11 and image 77 of the electronic display 15 when no power is supplied to the displays, providing the appearance of a plain dark panel to a viewer. When power is supplied to the displays so that light sources 38 and 16 are lit and/or so that vacuum fluorescent display 16 is made light emissive, the analogue display 11 and/or image 77 of the electronic display 15 become visible to a viewer through the cover 86. The support 34 and other unlit portions of the display remain invisible to a viewer of the display through cover 86.

The apparatus shown in Figure 1 includes a single analogue gauge. In the preferred implementation, the analogue display includes a complete set of analogue gauges, comprising multiple implementations of the light sources, gauge and pointer shown in Figure 1 to provide a complete range of analogue information to the vehicle driver. The analogue gauge content of the preferred implementation resembles that of a conventional analogue instrumentation cluster.

The electronic display 15 may provide any type of electronic display information, including display information similar to that currently available in electronic instrumentation clusters, such as fixed

digital displays or reconfigurable displays.

Figure 1 includes a bank of warning lights 78 (only one shown) mounted on circuit board 74. Each light in the bank of warning lights 78 comprises any suitable light emissive lamp which operates to project a warning image 85 off of optical element 90. The example warning light shown includes a light source 80, mounted on circuit board 74, with reflector 82 providing lighting of warning graphics plate 84, which is the source of the projected warning image 85.

A PRNDL display 88 of a type well known to those skilled in the art (giving information on the selected gear of an automatic transmission), powered by cable 96, may also be included in the display.

Referring to Figure 2, in a second embodiment of display apparatus, cover 86 may either be omitted as shown or included as a clear cover (not shown). The optical element 90 is replaced with an optical element 100 while a cover 102, mounted over vacuum fluorescent display 76, is added.

Optical element 100 performs the "hiding" function for the analogue display 11. To perform this "hiding" function, optical element 100 is partially light transmissive, preferably having a light transmissivity of less than 50 percent, which is generally less than the light transmissivity of optical element 90 of Figure 1. With the low light transmissivity of optical element 100, the analogue display 11 is not visible through optical element 100 unless the light sources (16,38) for the analogue display 11 are lit.

Optical element 100 also performs the combining function (which, in Figure 1, was performed by

optical element 90). The digital display, when light emissive, projects image 77 reflected off of optical element 100.

The partially light transmissive cover 102 of the digital display 15 is preferably less than 50 percent light transmissive to perform the hiding function for electronic display 15.

Both the cover 102 and optical element 100 may be formed from a dark coloured plastics material to provide the reduced transmissivity and the reflectivity required by optical element 100. Any suitable alternative compositions of cover 102 and optical element 100 may be used. One alternative composition for optical element 100 is a clear lens with an aluminium coating to provide partial reflectivity and partial light transmissivity.

Similar to Figure 1, the apparatus shown in Figure 2 may be implemented to provide a variety of analogue gauges in a full range analogue display and the digital display may be implemented to provide a wide variety of information.

Figure 3 illustrates an operator's view of a display of the type shown in Figures 1 or 2 when only the analogue portions of the display are lit. The example shown includes the display of an analogue speedometer 110, an analogue fuel gauge 112 and an analogue tachometer 114.

Figure 4 illustrates an operator's view of a display of the type shown in Figures 1 or 2 if only the electronic display 15 is lit. The view shown includes left and right turn signals 116 and 118, a digital fuel gauge 120, a full beam warning light 122, a digital speedometer 124 and electronic temperature and voltage

gauges 126 and 128.

Figure 5 illustrates an operator's view of a display of the type shown in Figures 1 or 2 with an example selection of a portion of the analogue display 11 and a portion of the electronic display 15. The analogue portions of the display include speedometer 110 and fuel gauge 112. The electronic display portions include left and right turn signals 116 and 118, full beam indicator 122 and temperature and voltage gauges 126 and 128.

Figure 6 illustrates an operator's view of a display of the type shown in Figures 1 and 2 with a second example selection of a portion of the analogue display and a portion of the electronic display. The analogue portion of the display includes a tachometer 114. The digital portion of the display includes left and right turn signals 116 and 118, digital fuel gauge 120, full beam indicator 122 and digital speedometer 124.

Figures 3 to 6 illustrate the flexibility of appearances of the embodiments of Figures 1 and 2, providing a wider variety of display appearances over a single display. For the most complete flexibility, the electronic display is preferably capable of providing completely redundant information to a full feature analogue display. If so implemented, portions of the redundant electronic display can be selected to be viewed in place of portions of the analogue display. Additionally, the electronic display can be implemented to provide information not typically displayed in analogue gauges. This additional information includes any information currently available in vehicle electronic displays.

Referring to Figure 7, the two-page display system shown schematically illustrates that the analogue display comprises a set of analogue gauges 158, 160 and 162, corresponding to speedometer 110, fuel gauge 112 and tachometer 114 in Figure 3. Likewise, the electronic display 15 comprises a set of electronic display information 164, 166, 168, 170, 180, and 182, corresponding to left turn signal 116, digital speedometer 124, digital fuel gauge 120, full beam warning 122, temperature gauge/voltage gauge 126 and 128 and right turn signal 118 in Figure 4, respectively.

Input 138 receives operator input indicative of the information desired from among the set of analogue gauges and the set of electronic display information. The input 138 may comprise a panel of push button switches easily implemented by one skilled in the art.

Controller 132 comprises circuitry responsive to conventional vehicle parameter signals provided through bus 130, including analogue gauge circuitry 134 and electronic display circuitry 136. Controller 132 is responsive to the input 138 and selectively controls the individual analogue gauges and electronic display information through lines 140-156 so that the combination of analogue gauges and digital display information selected by the operator is activated and visible. The above-described Figures 3 to 6 illustrate example selections.

Controller 132 comprises any type of controller-responsive switching means well known to those skilled in the art suitable for switching on and off the light sources for the analogue display and for selectively switching on and off portions of the

electronic display.

In a preferred implementation, the controller is implemented so that as a portion of the analogue display is selected, the redundant portion in the digital display is automatically turned off, and vice versa. Also in the preferred implementation, when an electronic display information is selected in place of the corresponding analogue gauge, power to the corresponding gauge is cut so as to minimize the current requirement of the display. This may be accomplished by one skilled in the art by placement of switching devices between the leads to the gauges 42 and the power supply.

Referring to Figure 8, a flow chart of the operation of the system of Figure 7 is shown. The operation begins at block 190 by providing a set of true analogue gauges that may be selectively made visible or hidden. The set of true analogue gauges may be provided by the apparatus shown in Figure 1 in a configuration of the type shown in Figure 3. At block 192, a set of electronic display information is provided by the electronic display 15 of Figure 1 and Figure 4. The electronic display information is selectively controllable to be hidden or to be viewed in combustion with selected analogue gauges. The set of electronic display information contains information redundant to at least some members of the set of analogue gauges.

At block 194, the display method receives operator input of selection set, selecting members of the set of true analogue gauges and of the set of electronic display information. The selection set may be input by any suitable means such as input 138 shown in Figure 7.

At block 196, the selected members from the

true analogue gauges and electronic display information are illuminated. The control is provided so that when redundant electronic display information is selected, the corresponding analogue gauge is hidden, and vice versa.

Figure 9 shows an implementation of the input means and controller 133 for a single member of the set of analogue gauges. The analogue gauge is made visible or hidden through control of light sources 16 and 38 via switch 201.

Figure 10 shows an implementation of the input and controller 133 for a single member of the set of electronic display information. The switch 203 is used selectively to provide power to the filament drive 200. Filament drive 200 may be an inverter or any other type of AC signal source used to provide power to the filament 202 in the portion of the vacuum fluorescent display corresponding to the selected electronic display information. When power to the filament is cut, the display is extinguished and when power is provided to the filament, the selected electronic display information is made visible.

Figure 11 illustrates an implementation of the input 138 and controller 132 tying control of corresponding displays together. For example, if gauge 42 is for the analogue speedometer and filament 202 is for the digital speedometer, when switch 205 is closed, power is cut to the gauge 42 and light sources 16 and 38, via inverter 208, diode 214 and switching device 210 (e.g., a power transistor). The result is that the analogue speedometer is turned off and remains hidden. At the same time, the switching device 212 (e.g., also a power transistor) provides power to the filament drive

200 and filament 202, lighting the digital speedometer, so that the digital speedometer becomes visible.

The above input and controller (Figures 9, 10 and 11) be duplicated for each analogue gauge and each portion of the electronic display for which individual control is desired.

Figure 12 illustrates the apparatus of Figures 1 or 2 mounted in a vehicle instrumentation panel 224, beneath the vehicle windshield 220, and viewable by vehicle driver 222.

In alternative embodiments, the panel 18 in the analogue display 11 may be lit by any other suitable lighting means, such as fluorescent lighting and lighting systems incorporating light pipes and/or alternative light sources. Also, the lit pointer for the analogue display may comprise other suitable types of lit pointer, including a pointer in which a light source is provided on the pointer arm. Such implementations are known to include xenon bulbs and LEDs constructed into the pointer arm.

The examples of the switching means and controller described above may be replaced by any equivalents that perform the functions of operator selection and display control in response to operator selection. Variations may include panels of push-button switches coupled to a microprocessor or integrated circuit used to control the lighting of the display in response to the operator input.

In the above implementations, the electronic display is controlled by controlling the filament power source. However, control of vacuum fluorescent display anodes and/or inhibiting the control signals thereto, would work equally well.

In embodiments where the analogue gauge or gauges are lit from the front of the display, the first and second lighting units 16,38 could be combined in a single unit.

The disclosure of our co-pending British patent application No.GB9304648.0(RJ/3786) filed the same day as this application is incorporated herein by reference.

Claims:

1. Display apparatus for a vehicle instrument panel comprising an analogue display panel mounted in a plane substantially perpendicular to a viewing direction of the display apparatus; first lighting means for illuminating the analogue display panel; at least one analogue gauge including a rotatable spindle; a pointer mounted on the rotatable spindle and adapted in use to be illuminated; second lighting means for illuminating the pointer; an electronic display mounted in a plane substantially parallel to the viewing direction; an optical element disposed at an angle relative to the analogue display panel, the analogue display panel and pointer being visible through the optical element when the first and second lighting means are lit, an image of the electronic display being projected by the optical element when the electronic display is actuated; and hiding means for hiding from view the analogue display panel when the first lighting means is not lit, the pointer when the second lighting means is not lit and the electronic display when the electronic display is not actuated.

2. Display apparatus according to claim 1, comprising a plurality of analogue gauges, selectively actuable first lighting means being provided for each analogue gauge; and a plurality of selectively actuable electronic displays.

3. Display apparatus according to claim 1 or 2, comprising input means for selecting the analogue gauge or gauges and/or the electronic display or displays to be viewed; and control means responsive to the input means for controlling the first and second lighting means and the electronic display or displays to

enable viewing of the selected analogue gauge or gauges and/or electronic display or displays.

4. Display apparatus according to claim 1, 2 or 3, wherein the optical element is partially reflective and partially transmissive.

5. Display apparatus according to claim 1, 2, 3 or 4, wherein the hiding means includes the optical element.

6. Display apparatus according to claim 5, wherein the optical element is formed from a dark plastics material.

7. Display apparatus according to any preceding claim, wherein the hiding means includes a partially light transmissive cover covering the electronic display.

8. Display apparatus according to any one of claims 1 to 4, wherein the hiding means comprises a partially light transmissive and partially opaque cover.

9. Display apparatus according to claim 8, wherein the cover is formed from a dark coloured plastics material.

10. Display apparatus according to any preceding claim, wherein the optical element comprises a partially silvered mirror.

11. Display apparatus according to any preceding claim, wherein the optical element comprises a combiner.

12. Display apparatus according to any preceding claim, wherein the first and second lighting means are one individual lighting means.

13. A method of displaying information comprising the steps of providing a set of analogue gauges, each controllable to be illuminated and visible

or non-illuminated and hidden; providing a set of electronic displays containing information redundant to at least one of the analogue gauges, each controllable to be non-illuminated and hidden or illuminated and viewed in combination with illuminated analogue gauges; receiving and operator input selection indicative of the analogue gauge or gauges and/or the electronic display or displays to be illuminated; and illuminating the selected analogue gauge or gauges and/or electronic display or displays, wherein if an electronic display redundant to one of the analogue gauges is selected, said analogue gauge is not illuminated so as to be hidden.

14. A method according to claim 13, wherein if an electronic display redundant to one of the analogue gauges is not illuminated, said analogue gauge is illuminated so as to be visible.

15. Display apparatus substantially as hereinbefore described with reference to and as illustrated in Figure 1 or 2 and Figures 7, 9, 10 and 11 of the accompanying drawings.

16. A method of displaying information substantially as hereinbefore described with reference to and as illustrated in Figures 3 to 6 and 8 of the accompanying drawings.